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The Sundarban of India and  
its biota<sup>1</sup>

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(With a plate)

PHYSIOGRAPHY

The Sundarban is a tropical humid forest belt that stretches from the Hooghly river (India) on the west to the Meghna river (Bangladesh) in the east. It spreads over the southern part of three districts, namely, 24 Parganas (India), Khulna and Backarganj (Bangladesh). The boundary of the Sundarban within West Bengal is demarcated by the Raimangal and Hooghly rivers in the east and west respectively, and the Bay of Bengal in the south. The northern limit cannot be clearly defined due to progressive reclamation of the land over the last 150 years. The area lies approximately between 21° 0'-21° 21' N and 88° 0'-89° 0' E.

The forest spreads over the Gangetic delta which is low, flat and alluvial, and is intersected from north to south by several wide rivers, numerous sluggish winding creeks and is interspersed with lagoons. The water in these creeks, pools and rivers is saline. The humid forests

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which grow on such delta is known as 'mangrove swamps' and such forests stretch for about 240 kilometres (150 miles) from west to east and are approximately 48 kilometres (30 miles) wide. Out of 11520 sq. kilometres (4500 sq. miles) the total forest area of 4096 sq. kilometres (1630 sq. miles) is now under Indian administration. Of this area, 2320 sq. kilometres (997 sq. miles) are covered with forests and the rest is water (Mitra 1954). The principal rivers of the area have a general north-south course towards the sea. Some of these rivers join and lead to the estuaries, namely, Hariabhanga, Gusaba, Matla, Thakuran, Saptamukhi and Muriganga. The principal rivers which open into the estuaries by traversing the Sundarban from east to west are Kalindi, Raimangal, Jhilla, Gusaba, Bidya, Matla, Thakuran, Saptamukhi and Baratala. They are tidal rivers and receive three tides a day. The difference in the water levels between high and ebb tides varies from six metres (20 feet) to 20 centimetres (8 inches) depending on the phase of the moon.

The estuarine islands of the Sundarban from east to west are Bangaduni, Dalhousie, Halliday, Bullcherry, Lothian, Farserganj (Mackleenberg). Numerous islands in the estuaries are still under formation.

The formation of alluvial surface and the alteration of river courses in Lower Bengal has been discussed in detail by Oldham (1893). The meandering action of rivers in the low lying Sundarban area helps in the creation of innumerable islands. The silt and loam brought down by the rivers from the north and poured on to the continental shelf undergo partial transformation due to exchange reactions with sea water (Raychoudhuri *et al.* 1963, p. 51). These constituents remain in suspension and are forced into the creeks, channels and rivers by high tides. The constituents in suspension settle down due to gravitational force and are deposited on the bed and the salinised soil is gradually covered with mould. After the soil is stabilised, further deposition of alluvium helps in elevating the edges which give rise to a natural embankment and a saucer-shaped depression is formed inside where in the course of time signs of life become visible when the monsoon rains wash the salinity off the place. Some shrubs and trees take root and gradually a dense forest flourishes in a place which once was under water.

The soil of the Sundarban is generally clayey loam and grey to greyish-black in colour. Sandy and alkaline soils are found on islands facing the Bay and at many degraded places on the surface. Raychoudhuri *et al.* (op. cit., p. 40) gave the composition of the low lands of the 24-Parganas district as follows: 'The soils in general are deficient in nitrogen which ranges from 0.02 to 0.09 per cent. The soils respond to application of nitrogenous fertilizers and give a yield increase of about 240 lbs. per acre. The phosphate in the soils varies from 0.1 to

0.15 per cent in the riverine and flat lands, and 0.06 to 0.1 in low lands. The pH of this soil ranges from 7.0 to 8.0 and potash varies from 0.3 to 1.0 per cent in the riverine and flat lands. Calcium oxide in the riverine and flat lands is high, ranging from 1.0 to 5.0 per cent.'

The soils of the Sundarban may be classified into four main categories:

1. *Matial*: Clayey soil, whitish, loose and light in composition. When reclaimed it is rich in plant nutrition and supports a good cultivation. It is also rich in calcium and magnesium and partially decomposed matter.

2. *Baliara* or *Dorosa*: Loamy soil reddish in colour, retains moisture longer than the other three types of soil. Coarse paddy may be grown.

3. *Dhap*: Whitish soil, lies at higher levels than other classes. Salt is not washed off. This is degraded alkali soil and, therefore, only such coarse vegetation as thatch grass (*Ulu*), grows on it.

4. *Dhal*: Found on newly formed islands which get flooded either due to high tide or due to rain water. The soil is reddish in colour and cracks when dry. Nothing substantial grows on such land.

The rivers of the Sundarban are subject to tidal influence and are, therefore, saline. The rivers between Rajmangal and Matla in the east and Muriganga and Hooghly on the west receive fresh water from the Ichhamati and Hooghly respectively, so that their salinity is greatly reduced. The increase in the salinity of the rivers of the western Sundarban appears to be a recent phenomenon, which is evident from Major Rennel's atlas of 1781 and Morrieson's of 1811; in both some villages are shown along the Sundarban rivers where today only dense forests exist. Those villages had evidently been abandoned by later increase in the salinity of the adjacent rivers leading to failure of agriculture.

Extreme climatic conditions do not prevail in the Sundarban. The network of creeks and rivers and the nearness of the Bay help in controlling the extreme climate. A typical tropical monsoon climate with excess of humidity is prevalent for about six months of the year, the day being moderately warm, equitable and humid, and there is a slow increase in the night temperature. The cold weather prevails from November to January and the rainfall during the period is negligible (mean of these three months is 2.5 cm). The mean maximum temperature for the years 1955-1960 is 30°C and the minimum 15°C. The temperature begins to rise from February and February, March and April are comparatively dry. Occasional thunder-storms accompanied by rains start from April. In May and October-November cyclonic storms occur. The cyclone causes high waves and combined with high tides frequently brings devastation to the area. The mean temperature

for six years (1955-1960 for February, March and April) is 31.8°C (maximum) and 26.6°C (minimum). The monsoon generally starts from the middle of June and continues till October, and the mean temperature slowly diminishes during the rainy season, but the humidity goes on increasing to 95 per cent. The total annual rainfall (average of the above-mentioned six years) is 265 cm and the average of the monsoon months for those six years is 230 cm.

## BIOTA

### Flora

The vegetation of the Sundarban may be broadly classified as (a) the sea-face (beach forests), (b) the formative island flora, (c) the flora of the reclaimed low-lying cultivated tracts, and (d) the swamp forests.

The present forest area covers about 2320 sq. kilometres (997.9 sq miles) of the delta. Special type of the marsh vegetation composed of elements mainly of the Malay Peninsula and Polynesian regions, together with some Indo-Chinese, Ethiopian and a few of the New World, is represented in these estuarine islands, not found elsewhere except in a small part of Mahanadi and Godavari deltas and the Bay islands. Prain (1903) listed 334 species of plants in the Sundarban, and stated that the different possible means of dispersal and distribution of plants such as by sea and rivers, and by wind, bird and human agencies, have been responsible for introducing an interesting and complex flora in the area.

Champion (1936) classified the Sundarban forests as moist tropical seral forest type (primary seral type), which he described as (a) 1S/1 beach forest and (b) 1S/2 tidal forests. The tidal forests are subdivided into four sub-types, namely, 1S/2 (a) low mangrove forests, 1S/2 (b) tree mangrove forests, 1S/2 (c) salt-water *Heritiera* forests and 1S/2 (d) freshwater *Heritiera* forests. Except the low mangrove and the salt-water *Heritiera* forests the other types of tidal forests do not occur in the Sundarban that lies within the Indian territory.

#### *Sea-face (beach) flora.*

The beach forest occurs on the sea-face islands. Sea-sand blown by strong winds form low sand-dunes. The sands, together with lime formed from disintegrating shells and salt, give rise to a pronounced xerophytic habitat, inspite of the facts that the rainfall in this area is over 125 cm (50 inches) and the subsoil water is just below half a metre or so. These conditions are very different from those prevailing in swamp islands, and thus provide a foothold for the littoral south-east Asian species. The islands are subject to strong north-western storms from

March till May and to cyclones which develop from Bay of Bengal in May and October-November. These cyclones cause considerable damage to the biota of the islands. The trees get uprooted and those that stand the rigours are stunted and deformed, devoid of branches and are more or less leafless. Savannah flourishes under such conditions. The sand-dunes are partially covered with tall brown spear-grass and a fence of shrubs and creepers immediately follows the sand-dunes.

A list of the more important species of plants occurring under such conditions are given below.

Species	Local name	Type of plant	Remark
Family TAMARICACEAE			
<i>Tamarix troupitii</i>	Jhao	Shrub or tree	Grows up to 7 metres
Family LEGUMINOSAE			
<i>Erythrina variegata</i>	Palita Mandar	Prickly tree	
<i>Canavalia maritima</i>		Sand-binder, climber	
<i>Canavalia gladiata</i>		Extensive sand-binder, climber	
<i>Derris scandens</i>	Nonalata	Large climber	
<i>Derris sinuata</i>	Sundrilata	Climber	
<i>Caesalpinia bonducella</i>	Nata	Large thorny climber	
Family FICOIDAE			
<i>Sesuvium portulacastrum</i>	Noona	Extensive climber	Excellent sand-binder
Family COMPOSITAE			
<i>Wedelia scandens</i>	Keshraj	Climber over bushes	
<i>Launaea sarmentosa</i>		Herb	Sand-binder
Family MYRSINEAE			
<i>Aegiceras corniculatus</i>	Kulsi	Tree	Grows up to 7 metres
Family SALVADORACEAE			
<i>Azima tetracantha</i>	Trikanta gati	Thorny shrub	
Family CONVULVULACEAE			
<i>Ipomoea pes-caprae</i>	Chhagalburi	Herb	Very common, excellent sand-binder
Family FLAGELLARICEAE			
<i>Flagellaria indica</i>	Kuh-bent	Cane-like climber	
Family CYPERACEAE			
<i>Pycneus polystachyos</i>	Junglimodhi	Sedge	Sand-binder
<i>Fimbristylis</i> spp.	Halaiya	Sedge	Sand-binder
Family GRAMINEAE			
<i>Oryza coarctata</i>	Bani-Dhan	Perennial grass	excellent sand-binder

<i>Phragmites karka</i>	Nal	Tall reed-like grass	Sand-binder
<i>Imperata cylindrica</i>	Ulu	Wiry grass	-Do-
<i>Zoysia martella</i>		Wiry grass	-Do-
<i>Saccharum spontaneum</i>	Khagra	Tall grass	
Family MALVACEAE			
<i>Hibiscus tiliaceus</i>	Bhola	Heavy climber	
<i>Thespesia populnea</i>	Paraspipal	Tree	Grows up to 10 metres
Family POLYPODIACEAE			
<i>Acrostichum aureum</i>	Udobon	Fern	Bushy plant

#### Formative (new) Island or Bank Flora

The formation of a new bank is the outcome of natural process of erosion of the banks on one hand by sets of river current and on the other hand by the compensating acceleration of shelving alluvium on the opposite side. The formation of a new island has already been discussed under topography. On these banks and islands "chars", *Oryza coarctata* "Bani-Dhan" appears along with *Sesuvium portulacastrum* "Noona". These are sometimes associated with *Myriostachya wightiana* at the river edge when such an edge drops suddenly into deep water. In the second line of succession a belt of undershrub bushes of *Acanthus ilicifolius* "Hargoza" and young *Avicennia officinalis* "Baen" appears. After these get established, *Excoecaria agallocha* "Gengwa", and *Rhizophora* sp. "Goran", *Sonneratia* sp. "Keora", etc., are the last to establish themselves under protection of "Hargoza" and "Baen". When all these shrubs and trees have properly established themselves, the grass disappears.

#### Forest flora

##### Salt-water *Heritiera* Forest

Salt-water *Heritiera* forest is a low salinity forest that exists along the south-eastern border of West Bengal along Khulna District (Bangladesh). Since freshwater of the Ichhamati River flows into the Raimangal river, the rivers between the Raimangal and Matla have reduced salinity. This has helped in the growth of a fairly dense forest consisting of numerous species tolerant of such water. The average height of the forest trees is from 6 to 11 metres, but some trees like *Sonnerita* sp. "Keora" may attain a height of 20 metres or so. The girth of the trunk is moderate. In the sheltered bays and creeks mangrove occurs. The mangrove are largely *Rhizophora* "Garjan", *Bruguiera* "Kankra", *Ceriops* "Goran" and *Avicennia* "Baen". Typical pneumatophores, that is, respiratory roots of *Avicennia* that project above soil, locally known as "shulas", occur everywhere. The stilt roots of *Rhizophora* and *Bruguiera* are meant for support and are special adaptive features.

Mukherjee: Sundarban



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1. Fairly dense tall-tree forest; 2. A tidal creek flowing through dense low forest; 3. Morning exercise of water-birds at Sajnakhali forest; 4. Clusters of wild date-palm, a very common plant.





*Heritiera* "Sundri" which is found scattered over areas of a slightly higher level does not seem to have natural satisfactory regeneration. Along with *Heritiera*, *Sonneratia*, *Excoecaria*, *Carapa* spp., from the upper storey. The palms, *Phoenix paludosa* "Hental" which commonly grows gregariously everywhere on higher elevations, and *Nipa fruticans* "Golpata" though present infrequently are met with on wet mud-banks along the creeks. Mangrove like *Rhizophora* and *Bruguiera* exhibit 'vivipary' (young plants germinate in the fruit while attached to the mother plant). It remains viable until the seed is able to find soil after it drops in water, which may take considerable time.

#### Low Mangrove Forest

The low mangrove forest which lies between Matla and Muriganga is absolutely devoid of fresh-water, since the rivers in this area are cut off from the ramifications of the Hooghly in the north.

The whole forest area is on soft tidal mud which gets submerged by salt-water at every tide. A dense forest of very low average height (3 to 6 metres) covers the area. Here the vegetation is identical to that of the preceding type, except that *Sundri* and *Golpata* are practically absent. The trees are evergreen and cluster gregariously, the leaves are leathery and the seeds are viviparous. The most common trees are *Ceriops* sp. "Goran" and *Avicennia* "Baen" which occupy extensive areas but grow only up to two metres. The clusters of *Phoenix* sp. "Hental" are extremely common.

A list of some important trees, shrubs and grass which compose the flora of this type of forest is given below:

Species	Local name	Type of plant
Family MELIACEAE		
<i>Amoora cucullata</i>	Amur	Tree
<i>Xylocarpus moluccensis</i>	Passur	Tree
<i>Carapa obovata</i>	Dhundul	Tree
Family LEGUMINOSAE		
<i>Azalia bigugata</i>	Bhaila	Tree
<i>Cynometra ramiflora</i>	Singra	Tree
Family RHIZOPHORACEAE		
<i>Rhizophora candelaria</i>	Goran	Tree
<i>Rhizophora conjugata</i>	Goran	Tree
<i>Rhizophora apiculata</i>	Goran	Tree
<i>Ceriops tagal</i>	Goran	Tree
<i>Ceriops roxburghiana</i>	Goran	Tree
<i>Bruguiera gymnorhiza</i>	Kankra	Tree
Family LYTHRACEAE		
<i>Sonneratia apetala</i>	Keora	Tree
Family VEBENACEAE		
<i>Avicennia officinalis</i>	Baen	Tree
<i>Avicennia alba</i>	Baen	Tree

## Family EUPHORBIACEAE

<i>Excoecaria agallocha</i>	Gengwa	Tree
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## Family PALMAE

<i>Phoenix paludosa</i>	Hental	Palm
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*Flora of the Reclaimed Area*

The reclaimed cultivated tracts are low lying islands which some two hundred years ago were covered with dense forest. Gradual deforestation, cordoning of the islands with high embankments, and repeated monsoon washing of the salinity of the soil made the area cultivable. Many tanks were dug out filling up with rain-water to meet man's requirement of freshwater from the beginning of the human settlement in these reclaimed islands. Various trees and other plants were also introduced. Thus, a complex flora of the original Sundarban species together with some plants from other parts of India and even from abroad are found there today. A list of the more familiar introduced plants are given below:

Species	Local name	Type of plant
Family RHAMNACEAE		
<i>Zizyphus mauritiana</i>	Kul	Small tree
Family LEGUMINOSAE		
<i>Cyamopsis tetragonolobus</i>	Guar	Annual crop (60-100 cm)
<i>Sesbania grandiflora</i>	Bokphul	Soft-wood tree
<i>Tamarindus indica</i>	Tentul	Large tree
<i>Parkinsonia aculeata</i>	Belati kikar	Hedge
<i>Acacia nilotica</i>	Babul	Shrub or tree
Family MELIACEAE		
<i>Azadirachta indica</i>	Neem	Large tree
Family MYRTACEAE		
<i>Psidium guajava</i>	Payara	Small tree
Family AMARANTHACEAE		
<i>Amaranthus polygamus</i>	Champanote	Pot herb
Family PALMAE		
<i>Areca catechu</i>	Supari	Palm
<i>Cocos nucifera</i>	Narikel	Large palm
Family GRAMINAE		
<i>Oryza sativa</i>	Dhan	Cultivated crop

Some important common herbs, shrubs, and grasses that are met with in the rice fields and around the villages are listed below:

Species	Local name	Type of plant
Family LEGUMINOSAE		
<i>Phaseolus adenanthus</i>	Ban barbati	Climber
<i>Derris sineata</i>	Natua	Prickly shrub

Family CUCURBITACEAE		
<i>Coccinia cordifolia</i>	Ban chinginga	Climber
<i>Trichosanthes cucumerina</i>	Ban chinginga	Climber
Family RUBIACEAE		
<i>Ixora coccinea</i>	Rangan	Shrub
Family COMPOSITAE		
<i>Spaeranthus africanus</i>	Kantapalang	Climber
Family ASCLEPIADACEAE		
<i>Sarcolobus globosus</i>	Baolilata	Large climber
Family AMARANTHACEAE		
<i>Psilotrichum ferrugineum</i>	Rakto-siranchi	
Family LILIACEAE		
<i>Asphodelus tenuifolius</i>		
Family TYPHACEAE		
<i>Typha angustata</i>	Hogla	Tall reed
Family GRAMINAE		
<i>Paspalum scrobiculatum</i>	Kodo Dhan	Tall tufted grass
<i>Panicum</i> sp.	Bharanda	Coarse grass
<i>Andropogon aciculatus</i>	Chorkanta	Tufted coarse grass
<i>Phragmites karka</i>	Nal	Reed
<i>Arundo donax</i>	Sukna	Reed like grass

Besides the flora of the northern plains a number of littoral species occur in the reclaimed area along embankments and edges of creeks. Such species are:

Species	Local name	Type of plant
Family LEGUMINOSAE		
<i>Canavalia gladiata</i>	—	Extensive climber
<i>Vigna luteola</i>	—	Climber
<i>Derris trifoliata</i>	Panlata	Shrub
<i>Pongamia pinnata</i>	Koronja	Tree
<i>Caesalpinia crista</i>	Singrilata	Shrub
Family COMPOSITAE		
<i>Wedelia</i> sp.	Bhimarj	Creepers
Family MYRSINEAE		
<i>Aegiceras corniculatum</i>	Khalsi	Tree
Family VERBENACEAE		
<i>Avicennia officinalis</i>	Baen	Tree
Family LYTHRACEAE		
<i>Sonneratia apetala</i>	Keora	Tree
Family RUBIACEAE		
<i>Morinda bracteata</i>	Barachand	Tree
Family PLUBAGINEAE		
<i>Aegialitis rotundifolia</i>	Satari	Tree
Family EUPHORBIACEAE		
<i>Excoecaria agallocha</i>	Gengwa	Tree

Family ACANTHACEAE		
<i>Acanthus ilicifolius</i>	Nonajhar	Shrub
Family CYPERACEAE		
<i>Cyperus articulatum</i>	—	Grass
Family PALMAE		
<i>Phoenix paludosa</i>	Hental	Palm

## Fauna

### Forest Fauna

The extensive saline swamp-forests of the Sundarban spread over the greater part of the sea-face of West Bengal, are inhospitable for animals due to lack of sweet water. In these marshy tropical jungles which flourish on the islands that are washed by the tidal waters of sea, the animals that have adapted themselves by adjusting their habits are very few. Of them, special mention may be made of the Tiger, *Panthera tigris* (Linnaeus), which is dreaded, since all without exception, are said to be maneaters: the Estuarine Crocodile, *Crocodylus porosus* (Schneider), lies in wait for its prey on shores and creeks on soft mud of the tidal flats between bayonet-like stilt and knee roots, where walking is difficult and man sometimes becomes its victims; and the large poisonous snake, the King Cobra, *Ophiophagus hannah* (Cantor).

A hundred years ago the Sundarban forests were the home of many wild animals, some of which like the Javan Rhinoceros, *Rhinoceros sondaicus* Desmarest, and the Wild Buffalo, *Bubalus bubalis* (Linnaeus) are no longer there. The last record of the Rhinoceros from this area is based on the specimen collected in 1870 and preserved in the collection of the Zoological Survey of India, Indian Museum, Calcutta and the Wild Buffalo was known to have existed up to 1885. It is said that the Swamp Deer, *Cervus duvauceli* Cuvier, Muntjac, *Muntiacus muntjak* Zimmermann, and the Fishing Cat, *Felis viverrina* Bennet, existed on these swamp-islands, but these have not been recorded in recent years from the Sundarban forests that lie in West Bengal.

An exhaustive faunistic report is not within the scope of the present paper. However, commoner animals encountered by me in the course of visits during 1955-1960 to the area and those found by others are mentioned below.

### VERTEBRATES

#### Mammals:

The order primates is represented by a single species, the Rhesus Monkey, *Macaca mulatta* (Zimmermann). Mukherjee & Gupta (1965) have studied the peculiar habits of this monkey and its specialised

adaptation to the estuarine island life, where freshwater is not available at all except rain-water, rendering such areas normally unsuitable for primate life. The other mammals are the Tiger, *Panthera tigris* (Linnaeus) which leads an almost amphibious life in swamps, moving from one island to another by swimming through the large rivers and creeks, and during tidal bores it clings to low mangrove branches or is driven to elevated parts of some islands restricting its movement till normal conditions are restored. Its man-hunting is perhaps due to its inability to obtain sufficient food under such adverse conditions, as it is unable to kill the deer or pig that are found on these islands.

In the tidal rivers, the commonest aquatic mammal is the Little Porpoise or the Black Finless Porpoise, *Neomeris phocaenoides* (Cuvier). The other Cetacea that frequent the tidal waters are *Orcella brevirostris* (Owen) and *Stolia plumba* Cuvier.

### Birds

Sundarban forest has a wealth of waterbirds. Birds such as herons, egrets, storks, ibises, cormorants, shags, darters, etc. which nest in colonies find these forest areas safe and convenient for their living and breeding. The discovery of the existence of a natural bird sanctuary, namely, 'Pakhirala' at Sajnakhali in this area has already been reported by Mukherjee (1955).

#### Resident species:

1. White Ibis *Threskiornis melanocephala* (Latham)
2. Openbill Stork *Anastomus oscitans* (Boddaert)
3. Adjutant Stork *Leptoptilos dubius* (Gmelin)
4. Blacknecked Stork *Xenorhynchus asiaticus* (Latham)
5. Red Junglefowl *Gallus gallus* (Linnaeus)
6. Swamp Partridge or Kyah *Francolinus gularis* (Temminck)
7. Blackcapped Kingfisher *Halcyon pileata* (Boddaert)
8. Whitecollared Kingfisher *Halcyon chloris* (Boddaert)
9. Brownwinged Kingfisher *Pelargopsis amauroptera* (Pearson) (Prefers broad tidal rivers)

#### Seasonal visitors:

1. Whimbrel *Numenius phaeopus* (Linnaeus)
2. Curlew *Numenius arquata* (Linnaeus) (Occasional)
3. Blacktailed Godwit *Limosa limosa* (Linnaeus)
4. Little Stint *Calidris minutus* (Leisler)
5. Dunlin *Calidris alpinus* (Linnaeus)
6. Eastern Knot *Calidris tenuirostris* (Horsfield)
7. Curlew-sandpiper *Calidris testaceus* (Pallas)
8. Greenshank *Tringa nebularia* (Gunnerus)
9. Terek Sandpiper *Tringa terek* (Latham)
10. Snipebilled Godwit *Limnodromus semipalmatus* (Blyth)

#### Rare visitors:

1. Giant Heron *Ardea goliath* Cretzschmar
2. Spottedbilled Pelican *Pelecanus philippensis* Gmelin
3. Herring Gull *Larus argentatus* Pontoppidan
4. Lesser Crested Tern *Sterna bengalensis* Lesson

5. Large Crested Tern *Sterna bergii* Lichtenstein
6. Sooty Tern *Sterna fuscata* Linnaeus

There are several species of smaller perching birds that frequent the forests such as flycatchers, warblers, pipits, wagtails. Blyth's Mangrove Whistler, *Pachycephala grisola* Blyth is sometimes observed among the wild date palm clusters.

### Reptilia

The reptilian fauna is represented by snakes, lizards, and crocodile. No chelonians are known from the area.

1. Keelback *Amphiesma stolata* (Linnaeus)

Common species:

2. Hurriah *Enhydryis enhydryis* (Schneider)
3. *Hydrophis obscurus* (Daudin)
4. *Gerardia prevostiana* (Eydoux & Gervais)
5. Wart Snake *Acrochordus granulatus* (Schneider)

Uncommon estuarine species:

1. *Hydrophis nigrocinctus* (Daudin)
2. *Hydrophis caeruleus* (Shaw)
3. *Microcephalophis cantoris* (Gunther)

Terrestrial snakes:

1. Cobra *Naja naja* (Linnaeus)
2. King Cobra *Ophiophagus hannah* (Cantor)
3. Whip Snake *Ahaetulla nasutus* (Lacepede)
4. Indian Python *Python molurus* (Linnaeus)

Lizards:

1. Water monitor *Varanus salvator* (Laurenti)
2. Monitor Lizard *Varanus flavescens* (Gray)

There is a single species of crocodile, the Estuarine Crocodile *Crocodylus porosus* (Schneider), which inhabits the lower reaches of the tidal rivers.

### Amphibia

Amphibians on these islands are very few. The toad, *Bufo melanostictus* Schneider, is sometimes seen in certain elevated parts. The tree frog, *Rhacophorus maculatus* (Gray), is quite common.

### Fishes

The fishes are brackish water and marine forms, freshwater ones being totally absent.

The tidal rivers and creeks which flow through forest blocks and the estuaries that surround the forested islands on the sea-face contain varied species of sharks and brackish water fishes. The species of sharks that are commonly met with belong to the genera, *Chiloscyllium*, *Stegostoma*, *Scoliodon*, *Carcharhinus*, *Rhinobatus* and *Dasyatis*.

There are several species of Teleostomi of which a few important and common species that are commercially exploited are:

*Hilsa ilisha* (Hamilton)  
*Ilisha filigera* (Valenciennes)  
*Raconda russelliana* Gray  
*Nematalosa nasus* (Bloch)

*Anguilla bicolor* McClelland  
*Muraena tile* (Hamilton)  
*Muraenesox cinereus* (Forsk.)  
*Pisoodonophis boro* (Hamilton)

<i>Anodontostoma chacunda</i> (Hamilton)	<i>Xenentodon cancila</i> (Hamilton)
<i>Setipinna taty</i> (Valenciennes)	<i>Strongylura strongylura</i> (van Hasselt)
<i>Harpodon nehereus</i> (Hamilton) 'Nehere'	<i>Aplocheilus panchax</i> (Hamilton)
<i>Tachysurus jella</i> (Day)	<i>Oryzias melastigmus</i> (McClelland)
<i>Tachysurus caelatus</i> (Valenciennes)	<i>Mugil parsia</i> Hamilton
<i>Tachysurus gagora</i> (Hamilton)	<i>Mugil tade</i> Forskal
<i>Tachysurus maculatus</i> (Thunberg)	<i>Polynemus heptadactylus</i> Cuvier
<i>Tachysurus sagor</i> (Hamilton)	<i>Polynemus paradiseus</i> Linnaeus
<i>Tachysurus sona</i> (Hamilton)	<i>Eleutheronema tetradactylus</i> (Bloch) 'Gurjaoli'
<i>Mystus gulio</i> (Hamilton) 'Gule'	<i>Lates calcarifer</i> (Bloch) 'Bhetki'
<i>Anguilla bengalensis</i> (Gray)	

The sea-fishes that enter the backwaters are:

<i>Scatophagus argus</i> (Linnaeus) 'Butterfish'	<i>Otolithes maculatus</i> Cuvier
<i>Stromateus cinereus</i> (Bloch) White Pomfret	<i>Sparus datnia</i> (Hamilton)
<i>Parastromateus niger</i> (Bloch) Black Pomfret	<i>Toxotes chatareus</i> (Hamilton)
<i>Pampus chinensis</i> (Euphrasen)	<i>Brachirus pan</i> (Hamilton)
<i>Datnioides quadrifasciatus</i> (Sevastianov)	<i>Cynoglossus bilineatus</i> (Lacepede)
<i>Leiognathus blochii</i> (Valenciennes)	<i>Cynoglossus lingua</i> Hamilton 'Tongue Sole'
<i>Pama pama</i> (Hamilton)	<i>Mastacembelus armatus</i> (Lacepede)
	<i>Mastacembelus pancalus</i> (Hamilton)
	<i>Macrognathus aculeatum</i> (Bloch)

The goggle-eyed Gobiids attract the attention of every person due to their active, frog-like hopping on exposed mud-flats, specially during ebb-tide. Generally two species occur, *Periophthalmus keelreuteri* (Pallas) and *Boleophthalmus boddarti* (Pallas) and several other species. They are not of commercial importance.

#### Invertebrates:

The invertebrates that are found in the forest area are more or less are represented in the reclaimed area also, except some crop-pests and freshwater animals, and have been listed under that chapter (pp. 17-19). Oligochaeta have been, scanty, whereas several species of Polychaetes are found burrowing in the mud, such as, *Ficomatus macrodon* Southern, *Mercierella enigmatica* Fauvel, *Dendronerius estuarina* Fauvel, *Pomatoceros caeruleus* Schmard). The Gastropods that are found on the mud banks and in the wet places in the interior of the forests are *Nerita* sp., *Telescopium* sp., *Melongena* sp., *Ceratoda* sp., *Onchidium* sp. The Bivalva is represented by *Arca* sp., and several species of *Teredo* which are borers of mangrove tree-trunks that get submerged in tidal water. Arthropods are well represented on land and water. An interesting example is the 'Living Fossil', the King Crab, *Carcinoscorpius rotundicauda* (Latreille), which is not uncommon in the shallow waters of the sea-facing islands, sometimes it crawls ashore. The low-forest trees are often found to bear combs of the Rock-Bee (*Apis*

*dorsata*). The combs sometimes grow so large that they are hardly a few feet above the ground. Insects affecting forest timbers are many. Mention may be made of the Cerambycids, borer-beetles, that cause alarming damage to Goran, Keora, Garjan, Dhudul etc. With nightfall the dark forests of Sundarban glitter with fireflies (*Pteroptyx* sp.) and the water of the rivers and channels also pulsates with luminiscent life, in the plankton.

#### *Fauna of the reclaimed area*

The reclamation of the land which rose from mud and clay by deforestation and human settlement has upset the ecology, resulting in the disappearance of major part of the wildlife. What exists today in these cultivated tracts are some common forms of birds and aquatic fauna of the tidal creeks, common to both the reclaimed and the forested areas. From the northern part of the district some animals have immigrated and have established themselves in the reclaimed area, for example, the jackal, fox, civet cats, mongoose and rats. Freshwater fishes have been introduced in the freshwater (sweet-water) tanks, and various insect pests have appeared on cultivated crops which were not known when these areas were covered with virgin forests.

The fauna is represented by practically every group of animal though the higher vertebrates, specially the mammals, are poorly represented.

### VERTEBRATES

#### M a m m a l i a

The mammals in the reclaimed area are few.

<i>Suncus murinus</i> (Linnaeus)	House Shrew	<i>Bandicota indica</i> (Bechstein)	Bandicoot Rat
<i>Felis chaus</i> (Guldenstaedt)	Jungle Cat	<i>Rattus rattus</i> (Linnaeus)	Common Rat
<i>Felis bengalensis</i> (Kerr)	Leopard Cat	<i>Cynopterus sphinx</i> (Vahl)	Short-nosed Fruit Bat
<i>Canis aureus</i> (Linnaeus)	Jackal	<i>Taphozous longimanus</i> (Hardwicke)	Indian False Vampire
<i>Vulpes bengalensis</i> (Shaw)	Indian Fox	<i>Rhinopoma hardwickii</i> (Gray)	Lesser Rat-tailed Bat
<i>Viverricula indica</i> (Desmarest)	Indian Civet	<i>Hipposideros bicolor</i> (Temminck)	Bicoloured Leafnosed Bat
<i>Herpestes edwardsi</i> (Geoffroy)	Common Gray Mongoose	<i>Pipistrellus mimus</i> (Wroughton)	Pigmy Pipistrelle
<i>Funambulus pennanti</i> (Wroughton)	Five-striped Squirrel	<i>Scotophilus temmincki</i> (Horsfield)	Lesser Yellow Bat
<i>Mus booduga</i> (Gray)	Field Mouse		
<i>Mus musculus</i> (Linnaeus)	House Mouse		



## Birds

## Marsh birds

<i>Bubulcus ibis</i> (Linnaeus)	Cattle Egret
<i>Egretta intermedia</i> (Wagler)	Smaller Egret
<i>Egretta garzetta</i> (Linnaeus)	Little Egret
<i>Egretta alba</i> (Linnaeus)	Large Egret
<i>Ardea purpurea</i> (Linnaeus)	Purple Heron
<i>Ardea cinerea</i> (Linnaeus)	Grey Heron
<i>Butorides striatus</i> (Linnaeus)	Little Green Bittern
<i>Nycticorax nycticorax</i> (Linnaeus)	Night Heron
<i>Ardeola grayii</i> (Sykes)	Pond Heron
<i>Metopidius indicus</i> (Latham)	Bronze-winged Jacana

## Freshwater Marshes

<i>Gallinula chloropus</i> (Linnaeus)	Moorhen
<i>Hydrophasianus chirurgus</i> (Scopoli)	Pheasant-tailed Jacana
<i>Rostratula benghalensis</i> (Linnaeus)	Painted Snipe
<i>Charadrius dubius</i> (Scopoli)	Little Ringed Plover

In the vast cultivated tracts, the Openbilled Storks, *Anastomus oscitans* (Boddaert) feed on snails from paddy-fields, and are seen with the Redwattled Lapwing, *Vanellus indicus* (Boddaert).

The birds of prey found in the area are:

<i>Spilornis cheela</i> (Latham)	Crested Serpent Eagle
<i>Haliaeetus leucoryphus</i> (Pallas)	Pallas's Fishing Eagle
<i>Haliaeetus leucogaster</i> (Gmelin)	Whitebellied Sea Eagle
<i>Haliastur indus</i> (Boddaert)	Brahminy Kite
<i>Milvus migrans</i> (Boddaert)	Pariah Kite
<i>Accipiter badius</i> (Gmelin)	Shikra
<i>Accipiter trivirgatus</i> (Temminck)	Crested Goshawk
<i>Ichthyophaga ichthyaetus</i> (Horsfield)	Greyheaded Fishing Eagle
<i>Pandion haliaetus</i> (Linnaeus)	Osprey

## Open Water

<i>Podiceps ruficollis</i> (Pallas)	Dabchick
<i>Nettapus coromandelianus</i> (Gmelin)	Cotton Teal
<i>Dendrocygna javanica</i> (Horsfield)	Lesser Whistling Teal
<i>Anas crecca</i> (Linnaeus)	Common Teal
<i>Tadorna ferruginea</i> (Pallas)	Brahminy Duck
<i>Anas acuta</i> (Linnaeus)	Pintail
<i>Aythya nyroca</i> (Guldenstadt)	White-eyed Pochard
<i>Netta rufina</i> (Pallas)	Redcrested Pochard

## Sandbanks

<i>Tringa hypoleucos</i> (Linnaeus)	Common Sandpiper
<i>Tringa glareola</i> (Linnaeus)	Wood Sandpiper
<i>Calidris minutus</i> (Leisler)	Little Stint
<i>Capella gallinago</i> (Linnaeus)	Fan-tail Snipe
<i>Numenius phaeopus</i> (Linnaeus)	Whimbrel

<i>Circus aeruginosus</i> (Linnaeus)	Marsh Harrier
<i>Falco peregrinus</i> (Tunstall)	Peregrine Falcon
<i>Falco severus</i> (Horsfield)	Oriental Hobby
<i>Falco tinnunculus</i> (Linnaeus)	Kestrel
<i>Gyps bengalensis</i> (Gmelin)	White-backed Vulture
<i>Tyto alba</i> (Scopoli)	Barn Owl
<i>Otus scops</i> (Linnaeus)	Scops Owl
<i>Athene brama</i> (Temminck)	Spotted Owlet
<i>Bubo zeylonensis</i> (Gmelin)	Brown Fish Owl
<i>Bubo bubo</i> (Linnaeus)	Great Horned Owl

A few species of terns, and kingfishers are seen on the larger rivers and in flooded areas. These are:

<i>Gelochlidon nilotica</i> (Gmelin) Gull-billed Tern	<i>Sterna aurantia</i> (J. E. Gray) Indian River Tern
<i>Sterna bergii</i> (Lichtenstein) Large Crested Tern	<i>Sterna hirundo</i> (Linnaeus) Common Tern
<i>Sterna bengalensis</i> (Lesson) Indian Lesser Crested Tern	<i>Sterna albifrons</i> (Pallas) Little Tern
<i>Rynchops albigollis</i> (Swainson) Indian Skimmer	<i>Sterna fuscata</i> (Linnaeus) Sooty Tern
<i>Larus brunnicephalus</i> (Jerdon) Brown headed Gull	<i>Ceryle rudis</i> Lesser Pied Kingfisher
<i>Larus ridibundus</i> (Linnaeus) Black-headed Gull	<i>Halcyon smyrnensis</i> (Linnaeus) White-breasted Kingfisher
<i>Chlidonias hybrida</i> (Pallas) Whiskered Tern	<i>Alcedo atthis</i> (Linnaeus)
<i>Hydroprogne caspia</i> (Pallas) Caspian Tern	<i>Halcyon chloris</i> (Boddaert) White-collared Kingfisher
	<i>Halcyon pileata</i> (Boddaert) Black-capped Kingfisher

Besides, there are many species of doves, cuckoos, parakeets, rollers, barbets, woodpeckers, larks, swallows, drongos, crows, tree pie, shrikes, bulbuls, babblers, flycatchers, warblers, thrushes, pipits, sunbirds, flowerpeckers, and finches and other birds, which are not specifically mentioned, for Law (1954, 1956) has already published observational reports about the ornithology of the Sundarban.

### Reptilia:

The reptiles in the reclaimed area are represented by snakes and lizards.

The snakes comprise both terrestrial and aquatic forms. The terrestrial snakes are met with in fields and cultivation.

<i>Ptyas mucosus</i> (Linnaeus) Rat Snake	<i>Xenochrophis piscator</i> (Schneider) Common Checkered Keelback
<i>Vipera russelli</i> (Shaw) Russell's Viper	<i>Amphiesma stolata</i> (Linnaeus) Striped Keelback
<i>Naja naja kaouthia</i> (Lesson) Indian Cobra	<i>Enhydryis enhydryis</i> (Schneider) Hurriah
<i>Oligodon arnensis</i> (Shaw) Kukri Snake	<i>Hydrophis obscurus</i> (Daudin)
<i>Lycodon aulicus</i> (Linnaeus) Wolf Snake	<i>Gerardia prevostiana</i> (Eydux & Gervais)
<i>Eryx conicus</i> (Schneider) Russell's Sand Boa	<i>Acrochordus granulatus</i> (Schneider) Wart Snake

In the saline waters of rivers and creeks turtles and terrapins are sometimes come across:

### Lizards:

<i>Varanus flavescens</i> (Gray)	<i>Calotes versicolor</i> (Daudin)
<i>Varanus salvator</i> (Laurenti)	<i>Chamaeleon zeylanicus</i> (Laurenti)

## Turtles:

*Pelochelys bibroni* (Owen) Coast  
Soft Shell  
*Morenia ocellata* (Dumeril & Bibron)  
Bengal Eyed Terrapin  
*Batagur baska* (Gray) Batagur

*Lepidochelys olivacea* (Eschschottz)  
Ridley Turtle  
*Geomyda tricarinata* (Blyth) Three-  
keeled Terrapin

In the tidal rivers and creeks no frogs have been seen. In the water-puddles which are formed as a result of rainfall and in perennial sweet-water reservoirs, the amphibians that are met with are:

*Rana cyanophlyctis* Schneider. 'Chine-  
beng'  
*Rana hexadactyla* Lesson. 'Pati Beng'  
*Rana limnocharis* Wiegmann. 'Dhani-  
beng'

*Rana tigerina* Daudin. 'Sona-beng'  
*Bufo melanostictus* Schneider. 'Kuno-  
beng'. Very common. Dry land.  
*Microhyla ornata* 'Dumeril & Bib-  
ron'. Smallest frog in the area.

The fishes that are found in the sweet-water pools of the reclaimed areas are:

## Introduced species

*Labeo rohita* (Hamilton). Rui  
*Labeo calbasu* (Hamilton). Kalbose  
*Labeo gonius* (Hamilton)  
*Catla catla* (Hamilton). Katla  
*Cirrhinus mrigala* (Hamilton). Mrigal  
*Puntius* sp. 'Punti'  
*Danio* sp.  
*Chela* sp. 'Chela'  
*Ambassis* sp. 'Rangachanda'  
*Notopterus* sp. 'Pholui'

*Rita* sp. 'Rita'

## Mud fishes

*Mastacembelus armatus* (Lacepede)  
and *M. pancalus* (Hamilton).  
*Channa gachua* (Hamilton). Pank-  
achaks  
*Oryzias melastigmus* (McClelland).  
Techoko.

## Cat fishes

*Clarias batrachus* (Linnaeus) *Hetero-*  
*opneustes fossilis* (Bloch)

The other brackish water fishes which get into creeks of the reclaimed area have been dealt separately under the fauna of the forest area.

## INVERTEBRATA

The common invertebrates of the area are represented by the Phyla Mollusca, Arthropoda, and Annelida.

## Mollusca :

## Freshwater

*Viviparus bengalensis* (Lamarck)  
*Melanoides tuberculatus* (Muller)  
*Melanoides scabra* (Muller)  
*Lymnaea acuminata* (Lamarck)

*Indoplanorbis exustus* (Deshayes)  
*Pila* sp. (Widely dispersed by the  
monsoon waters)

## Arthropoda

## Crustacea:

Several species of crustaceans abound in freshwater ponds and jheels. The smaller prawns commonly found in freshwater are:

*Macrobrachium lamarrei* (Milne-  
Edward). 'Kuncho chingri'  
*Leander styliferus* (Milne-Edward)

*Caridina gracilipes* de Man. 'Ghunso  
chingri'  
*Macrobrachium rude* (Heller). 'Goda  
chingri'

During the monsoon very large number of prawns find their way from the brackish water into the paddy fields. In such flooded fields two species are met with:

*Metapenaeus brevicornis* Milne-Edward, 'Dhanboni chingri'

*Metapenaeus monoceros* Fabricius, 'Koraney chingri'

The most common crab in the paddy fields during the monsoon is the small grapsid crab *Varuna litterata* (Fabricius), 'Chiti kankra'. In brackish water the common forms met with are: *Scylla serrata* (Forsk.) (*Scylla*), *Portunus pelagicus* (Linnaeus), *Portunus sanguinolentus* (Herbst). *Matuta victor* Fabricius, which is also found in the tidal rivers but appears to be less common there. The common crab that attracts attention is the orange-coloured Fiddler Crab (*Uca* sp.) which actively moves about on mud-flats during ebb-tide in large numbers. The fresh-water crabs are: *Paratelphusa* (*Barytelphusa*) *jacquemontii* (Rathbun), and *Paratelphusa* (*Barytelphusa*) *spinigera* Wood-Mason are found in smaller numbers in freshwater tanks and flooded paddy fields. They appear to have been introduced by human agency. Certain deep burrows in soft mud banks of tidal creeks are the homes of the Ghost Crab, *Thalacina anomala* Herbst, which looks more or less like Lobsters hence it is locally known as 'Patal Chingri'.

Insecta:

The reclaimed areas which now are used for extensive cultivation of paddy have large number of insect pests that were probably not known in these areas a century ago when the islands were covered with forests. They appear to have followed paddy cultivation. Besides, there are several insects of minor significance, terrestrial as well as aquatic. It is not worthwhile to furnish a list of all insects that occur there but some more important pests of agricultural crops which were observed during 1955-1965 and some of the commoner aquatic bugs, beetles and dragonflies are mentioned below:

The agricultural pests, mainly of paddy, were found in the sprouting ears of *Aus*, and the nurseries of *Aman* crop.

Rice Thrips *Hispa* (*Di cladispa*) *armigera* Oliver

Paddy Curculionid *Tany mecus indicus* Faust

Some lepidopterus larvae are:

Swarming Caterpillar *Spodoptera mauritia* (Boisduval)

Rice Caseworm *Nymphula depunctalis* Guenee

Paddy Jassid *Nephotettix bipunctatus* Fabricius

During September and October when young plants of *Aman* paddy crop attained a height of 15 to 30 cm, the infection by caterpillars and thrips were appreciably reduced. The additional pests that were noticed then were: Ricehopper *Hieroglyphus banian* Fabricius which cause appreciable damage and Paddy Mealybug *Ripersia oryzae* Green which was found infecting certain plots only, specially those near swamp